# Fusion® series G2

## user manual

Mold Masters®
performance delivered

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# Section 1 Introduction

We would like to take this opportunity to thank you for purchasing a ***Mold-Masters*** Fusion G2® hot runner. The purpose of this manual is to assist users in the integration, operation and maintenance of ***Mold-Masters*** systems. This manual is designed to cover most system configurations. For additional information, please contact your representative or a ***Mold-Masters*** office.

**Please note that the responsibility for the safety of personnel remains exclusively with the employer. It is the obligation of the employer to properly train and instruct its personnel in the safe operation of equipment including maintenance and the purpose and proper use of all the safety devices. In addition, the employer must provide its personnel with all necessary protective clothing, including such items as a face shield and heat resistant gloves. Any instructional material provided by *Mold-Masters* for the operation and maintenance of equipment, does not in any way absolve the employer from fulfilling these obligations and *Mold-Masters* disclaims liability for injury to personnel using equipment supplied.**

## Warranty and Documentation

Your original system documentation contains warranty details. If for any reason, parts must be returned to ***Mold-Masters,*** it is essential to obtain prior pre-authorization and a return authorization number.

Documentation will include any or all of the following:

- Parts list containing all system components. Together with the general assembly drawing, the parts list should be referenced when ordering spare parts.
- General assembly drawing used to integrate your hot runner system into mold.
- Hot half drawing used to integrate hot half to cavity plate.

When ordering this manual, please reference document number: **MMFSUM**.

### Release Details

| Document # | Release Date | Version |
|---|---|---|
| MMFSUM02 | April 2010 | 02 |

This document has been reviewed by: Mold-Masters Application Engineering; Design Engineering; Sales and Marketing; Service.

**This manual should be used in conjunction with any appropriate *TempMaster* Temperature Controller User Manual.**

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# Section 2 Global Support

## Mold-Masters contacts worldwide

visit us online at **www.moldmasters.com**

## Manufacturing Facilities

**GLOBAL HEADQUARTER**
**CANADA**
Mold-Masters Limited
233 Armstrong Avenue
Georgetown, Ontario
Canada L7G 4X5
tel: +1 (905) 877 0185
fax: +1 (905) 873 2818
info@moldmasters.com

**EUROPEAN HEADQUARTER**
**GERMANY / SWITZERLAND**
Mold-Masters Europa GmbH
Postfach/P.O. Box 19 01 45
76503 Baden-Baden, Germany
Neumattring 1
76532 Baden-Baden, Germany
tel: +49 7221 50990
fax: +49 7221 53093
info@moldmasters.de

**ASIAN HEADQUARTER**
**CHINA/HONG KONG/TAIWAN**
Mold-Masters (KunShan) Co, Ltd
Zhao Tian Rd
Lu Jia Town, KunShan City
Jiang Su Province
People's Republic of China
tel: +86 512 86162882
fax: +86 512-86162883
mmc-sales@moldmasters.com

**SOUTH AMERICAN HEADQUARTER**
BRAZIL
Mold-Masters do Brasil Ltda.
Rua Hum, 1106 e 1126 -
Jd. Manchester - Nova Veneza
SumarÈ - São Paulo Brasil
CEP 13178-440
tel: +55 19 3922 4265
fax: +55 19 3922 4266
moldmasters@moldmasters.com.br

**INDIA**
Mold-Masters Technologies
Private Limited
# 247, Alagesan Road,
Shiv Building, Saibaba Colony.
Coimbatore T. N.
India 641 011
tel: +91 422 423 4888 - 20
fax: +91 422 423 4800
mmtplinfo@moldmasters.com

**JAPAN**
Mold-Masters K.K.
1-4-17 Kurikidai, Asaoku
Kawasaki, Kanagawa
Japan, 215-0032
tel: +81 44 986 2101
fax: +81 44 986 3145
info@mmkk.co.jp

**UNITED KINGDOM**
Mold-Masters UK
Netherwood Road
Rotherwas
Hereford
HR2 6JU
tel: +44 1432 265768
fax: +44 1432 263782
pms@pmssystems.com

**U.S.A.**
Mold-Masters Injectioneering LLC
103 Peyerk Court
Romeo, MI 48065
tel: +1 800 450 2270 (USA)
tel: +1 (586) 752-6551
fax: +1 (586) 752 6552
info@moldmasters.com

## Regional Offices

**AUSTRIA / HUNGARY**
Mold-Masters Handelsges.m.b.H.
Pyhrnstrasse 16
A-4553 Schlierbach
Austria
tel: +43 7582/51877
fax: +43 7582/51877 18
office@moldmasters.at

**FRANCE**
Mold-Masters France
ZI la Marinière,
2 Rue Bernard Palissy
91070 Bondoufle
tel: +33 1 82 05 00 80
fax: +33 1 82 05 00 83
mmf-info@moldmasters.eu

**KOREA**
Mold-Masters Korea Ltd
708 Byucksan Digital Valley 5 Cha,
60-73 Gasan-dong, Geumcheon-gu,
Seoul,153-788,South Korea
Tel:+82 2 2082 4755
Fax:+82 2 2082 4756
mmkr-sales@moldmasters.com

## Regional Offices - Con't

**MEXICO**
Mold-Masters Mexico
Av. Palmira 407
Villas Palmira,
Lomas del Marques
Queretaro, Qro. Mexico 76146
Tel: +52 442 2456378
egarrido@moldmasters.com

**SINGAPORE / MALAYSIA**
**INDONESIA / THAILAND**
Mold-Masters Singapore PTE. Ltd.
No 48 Toh Guan Road East
#06-140 Enterprise Hub
Singapore 608586
Republic of Singapore
tel: +65 6261 7793
fax: +65 6261 8378
mmsinfo@moldmasters.com

**SPAIN**
Mold-Masters España
Serennia Business Center
Buenos Aires 37-29
08902 Hospitalet de Llobregat
Barcelona, Spain
tel: +34 93 802 36 01
fax: +34 93 802 49 08
spain@moldmasters.eu

**UNITED KINGDOM**
Mold-Masters (UK) Limited
Unit 28, The Gateway
Birmingham Airport
Birmingham B26 3QD
United Kingdom
tel: +44 121 781 7800
fax: +44 121 782 4604
mmuk-all@moldmasters.co.uk

**CZECH REPUBLIC**
Mold-Masters Europa GmbH
Hlavni 823
75654 Zubri
Czech Republic
tel: +420 571 619 017
fax: +420 571 619 018
cz@moldmasters.eu

**POLAND**
Mold-Masters Europa GmbH
Skr. Pocztowa 59
00-908 Warszawa
Poland
tel: +48 (0) 66 91 80 888
fax: +48 (0) 66 91 80 208
pl@moldmasters.eu

## International Representatives

**Australia**
Comtec I P E
1084 South Road,
Edwardstown, South Australia 5039
PO Box 338, Magill,
South Australia 5072
tel: +61 8 8374 4633
fax: +61 8 8299 0892
bparrington@comtecipe.com

**Bulgaria**
Mold-Trade OOD
62, Aleksandrovska St.
Ruse City
Bulgaria
tel: +359 82 821 054
fax: +359 82 821 054
contact@mold-trade.com

**Denmark, Norway, Sweden**
Englmayer A/S
Skenkelsoevej 9, Postbox 35
DK - 3650 Oelstykke, Denmark
tel: +45 46 733847
fax: +45 46 733859
support@englmayer.dk

**Finland**
Oy Scalar Ltd.
Mestarintie 5
SF-12100 Oitti, Finland
tel: +358 19 783 191
fax: +358 19 783 190
info@scalar.fi

**Israel**
ASAF INDUSTRIES Ltd.
29 Habanai Street
PO Box 5598 Holon 58154
Israel
tel: +972 3 5581290
fax: +972 3 5581293
sales@asaf.com

**Italy**
Commerciale Isola SPA
Via G.B. Tiepolo 3
35010 Cadoneghe, (Padova), Italy
tel: +39 49 706600
fax: +39 49 8874231
info@com-isola.it

**Portugal**
Gecim LDA
Rua Fonte Dos Ingleses, No 2
Engenho
2430-130 Marinha Grande, Portugal
tel: +351 244 575600
fax: +351 244 575601
gecim@gecim.pt

**Romania**
International Mold Trade Co. SRL
Str. Constantin Aricescu, Nr. 21
Bl. 20, Sc. 2, Apt. 20
Bucharest - Sector 1, Romania
tel: +4 021 230 60 51
fax : +4 021 231 78 43
contact@matritehightech.ro

**Russia**
OOO Portmold
Gefsimanskie prudy 4, office 2
141312 Russian Federation
Moscow region
Sergiev Posad
tel: 007 495 743 48 65
fax: 007 496 549 25 26
moldmasters@portmold.ru

**Turkey**
MMG Consulting & Engineering
Yesil Çesme Sok No:30/3
Çiftehavuzlar 81060, Istanbul, Turkey
tel: +90 216 357 0783
fax: +90 216 385 0656
mmgevrek@superonline.com

**Vietnam**
Lotus Chemical Technology
393 Dien Bien Phu St., Ward 4, Dist. 3,
HoChiMinh City, Vietnam
tel: +84 8 832 7605,
fax: +84 8 832 7730
dieuphuoc.nguyen@lotusfirma.com

# Section 3 Safety

High injection pressures and high temperatures are used in the operation of hot runners. To protect the operator in the work place, ensure that all safety devices are installed on the machine.

- Be aware of all warning labels attached to the mold and machine.
- Refer to the machine user manual for safety procedures and checks not included here in the hot runner specific manual.

## Notices

To make the manual easier to use, we've included notices throughout that highlight important information. See below.

**SAFETY WARNING**:
Safety warning indicates a potentially hazardous situation, which if not avoided, could result in serious injury or death.


**CAUTION**:
Caution indicates that damage to equipment is possible if instruction is not followed.

**IMPORTANT**:
Important indicates useful additional information or is used as a reminder of important information.

## GENERAL SAFETY WARNINGS

The equipment supplied is subjected to high injection pressures and high temperatures. Ensure that extreme caution is observed in the operation and maintenance of the hot runner system and the injection molding machines.

- Do not operate the equipment with unconfined long hair, loose clothing or jewelry, including name badges, neckties, etc. These may get caught by the moving belt mechanism and can cause death or serious injury.
- Never disable or bypass a safety device.
- It is highly recommended that all operators wear face shields and use heat resistant gloves when working around the feed throat, purging the machine or cleaning the gates of the mold.
- Check frequently for possible oil leaks/water leaks. Stop the machine and make repairs.
- Remove purgings from the machine immediately.
- Never touch or inspect the timing belt when power is on and motor and controller are connected. Unplug the controller before any maintenance.
- Always cover belt area with proper protecting sheet before any bench test or in-mold testing.
- High Voltage and amperage cables are connected to the controller (220VAC). There is also a high voltage cable connection between servo motor and controller.
- Unplug the controller before performing any maintenance work.

## GENERAL SAFETY WARNINGS - Con't

- Hoses fitted to the mold will contain high or low temperature fluids or air under high pressure. The operator must shut down and lockout these systems as well as relieving any pressure before performing any work with these hoses.
- Never perform any work on the mold unless the hydraulic pump has been stopped.
- High voltage and amperage cables are connected to the mold. Electric power must be shut off prior to installing or removing any cables.
- Water and or hydraulics on the mold may be in close proximity to electrical connections and equipment. Water leakage may cause an electrical short circuit. Hydraulic fluid leakage may cause a fire hazard. Always keep water and /or hydraulic hoses and fittings in good condition to avoid leaks.

Check that all coolant, hydraulic and air lines as well as electrical cables will not interfere with the moving parts of the mold, machine or robot. The lines must be of sufficient length so that they will not strain or pinch when the mold halves separate.

## GENERAL CAUTIONS

- For water-cooled gate inserts, coolant must be maintained with the proper mixture to prevent corrosion and circuit blockage.
- Care must be taken to ensure the nozzle terminal ends do not come in contact with the hydraulic fluid. The nozzles may short out or become damaged.
- Do not mix electrical power cables with thermocouple extension cables. They are not designed to carry the power load or list accurate temperature readings in each other's application.

To maximize heater element and component life, the temperature must be controlled and maintained within safe operating limits. Mold-Masters strongly recommends individual control of each heated component, including heater plates, with a reliable temperature controller that includes soft-start protection.
All Mold-Masters heated components are manufactured to standards that ensure safe and reliable operation provided that the following precautions are met:

- Always operate the system using correctly installed "J" type thermocouples connected to a reliable temperature controller with "soft-start" protection.
- Avoid running the system for long periods on "manual" control.
- Use caution when applying power in "manual" mode. Use minimum heat required for the process to avoid overheating and possible damage to components.
- Always replace pinched or damaged thermocouples.
- When "grouping" heated components together and controlling more than one load from a single thermocouple, make sure that the components are of similar material, wattage, size and are exposed to the same thermal conditions.
- When replacing heater plates or other heated components always replace with genuine
- Mold-Masters components of the same type and install as originally specified on Mold-Masters general assembly drawings.

# Section 4 Preparation

## Introduction

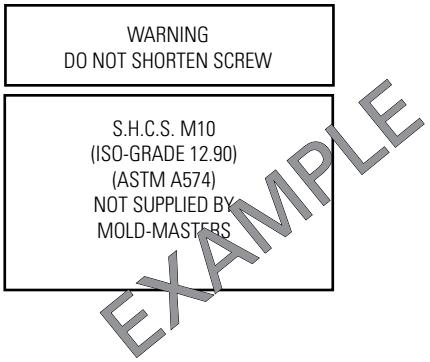
The following section is a step-by-step guide to preparing your Mold-Masters® system for use.

## Screw Lengths

**WARNING:**
The use of an incorrect size, length and grade screw could cause the screw to shear, fatigue or stretch beyond its yield point, resulting in expensive downtime of the hot runner.

Be aware of warnings placed on the assembly drawings. When the manifold is heated the metal expands stretching the mounting screws, if screw lengths are shortened there is a possibility of shearing.

The expansion factor is calculated into the length of each screw size.



## Tools Required

Depending on the size and complexity of your hot runner system, you will require most of the tools and materials listed below.

- Allen keys - Set of imperial size keys and metric sizes for use on both imperial and metric cap screws (depending on system).
- Anti-seize compound - To prevent oxidation of screw threads that could cause screws to seize with high temperatures.
- Solvents (denatured alcohol) - For removal of rust inhibitors.
- **Calibrated** torque wrench - For consistent screw pressure throughout the system.
- Depth micrometer - To check bore depths.
- Bluing Compound - For checking face contact.
- Sockets.
- Plastic face hammer.

## Unpacking

1. Carefully remove the system from the shipping box and check that the system is received in good condition and no damage occurred during shipment.
2. Check that all mold base dimensions are correct and correspond to ***Mold-Masters*** general assembly drawings.

## Cleaning

All nozzles, manifolds and hot runner components must be free of the rust inhibitor applied at the factory.

1. Remove protective covers from all gate seals.
2. Remove tape from inlet and clean.

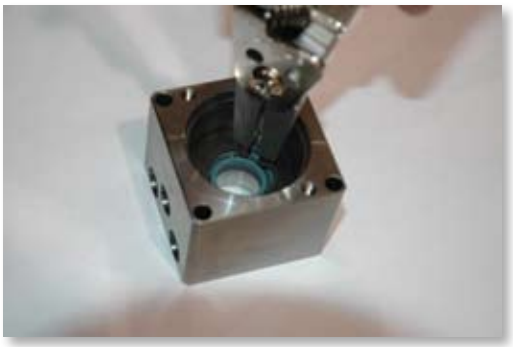
## Fusion G2 Hydraulic Cylinder Components

## Hydraulic Cylinder Assembly

1. Install the rod seal - RODSEAL06 (Two Piece Design.

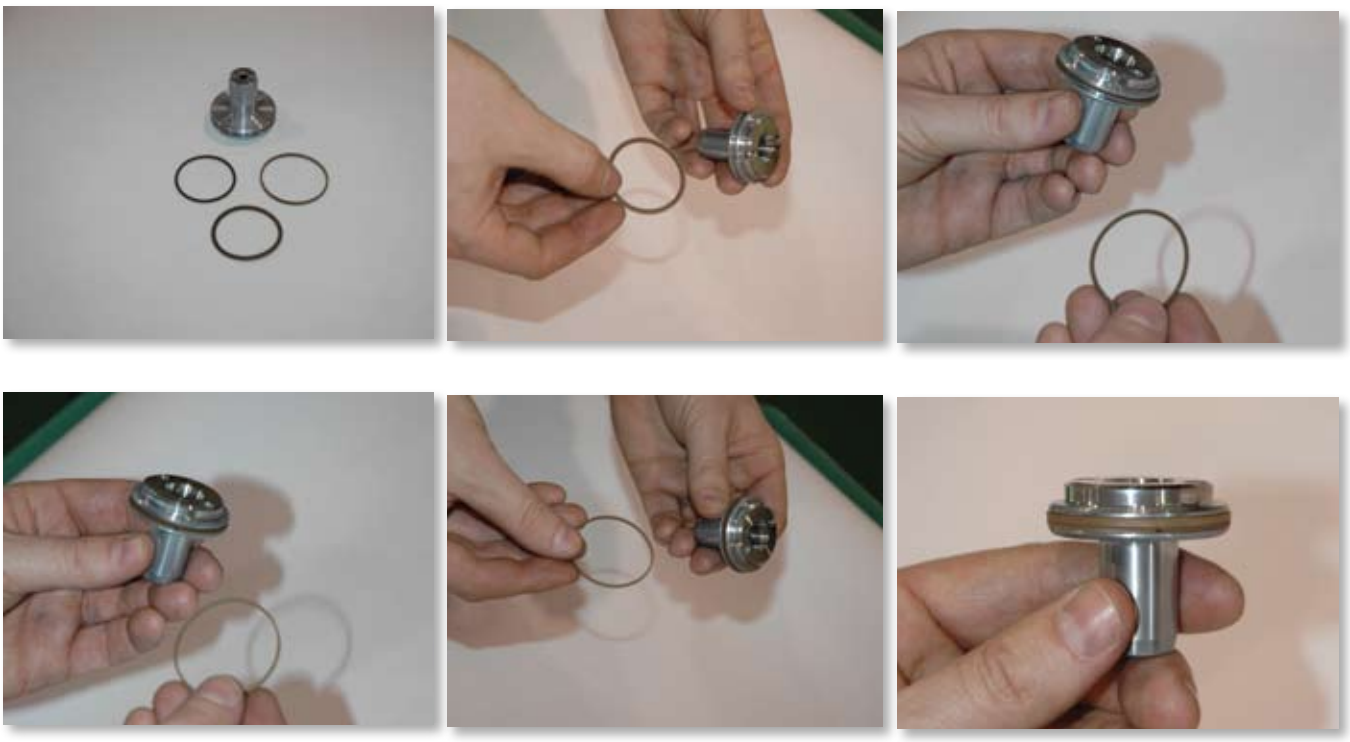
2. Press the seals into the housing.

3. Install the rod seal retainer clip - RGN130029.



4. Install the water circuit pipe plug - PP1/16-27 (Use pipe sealant on threads).

5. Install the piston seals - PS0003 (Three Piece Design)



6. Install the valve pin.

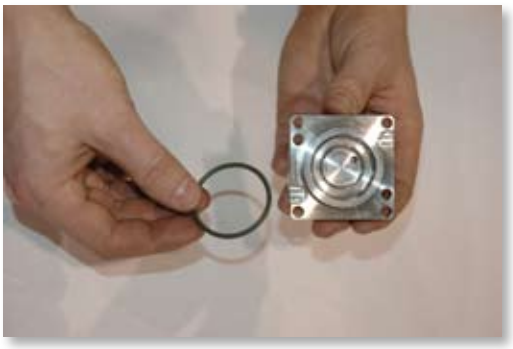
7. Install the valve pin spacer - SPACER42.

8. Install the piston top - HHPL-6HP50N-S.

9. Torque the piston top.

10. Install the cylinder top seal - PNOR2-129.

11. Install the cylinder bleeder valve - NIP-PLEM8X1.

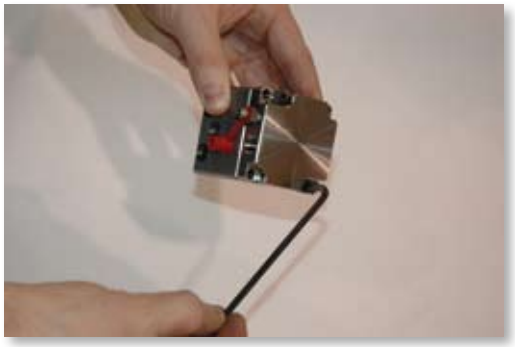


12. Assemble the piston into the cylinder bottom.

13. Assemble cylinder top to the cylinder bottom.

14. Apply anti-seize to the SHCS's.

15. Install the cylinder top SHCS's.

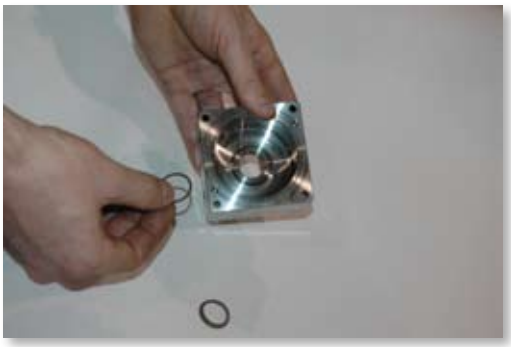


16. Assemble the cylinder to the manifold.
17. Apply anti-seize to the SHCS's.
18. Tighten and torque all SHCS's in a crossing pattern.

## Fusion G2 Pneumatic Cylinder Components - w/ Anti-Rotation

## Pneumatic Cylinder Assembly

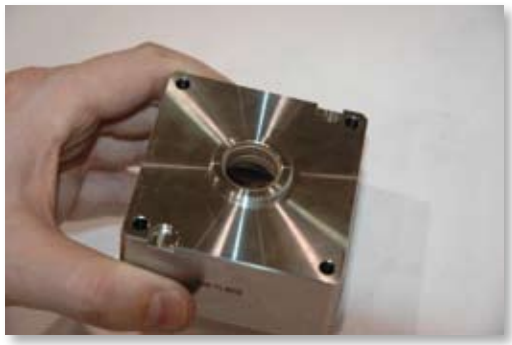
1. Install the rod seal - RODSEAL08 (Two Piece Design).




2. Install the piston, forming the seal into position.

3. Install the wiper seal - WS0002 (Two Piece Design).





4. Install the piston, forming the seal into position.

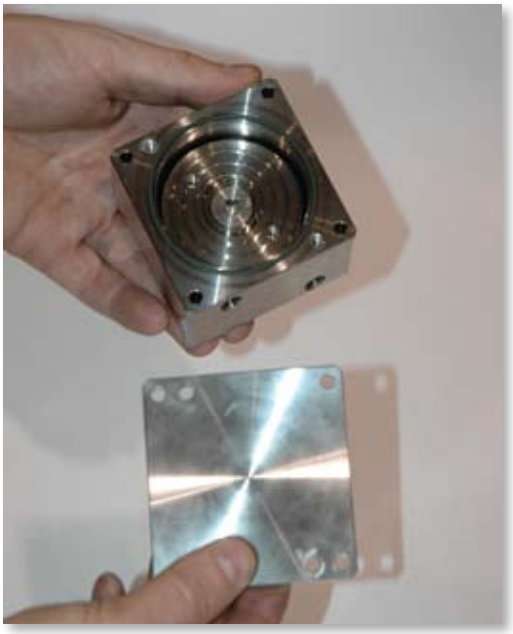
5. Install the piston seals - PS0012 (Two Piece Design).

6. Install the piston top - HHPL-6HP50N-S.
7. Torque the piston top.

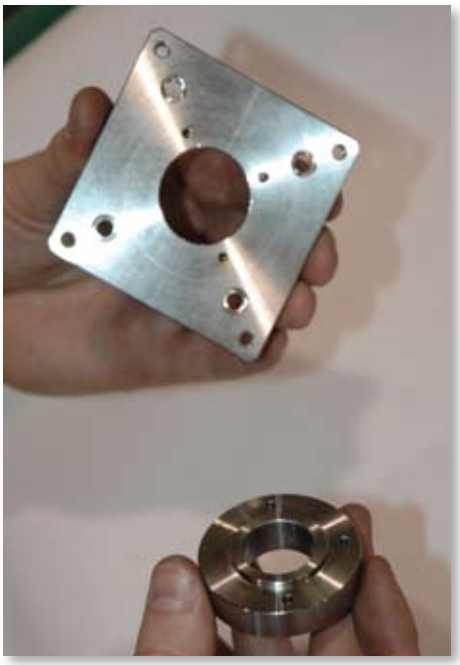
8. Assemble the piston into the cylinder bottom.

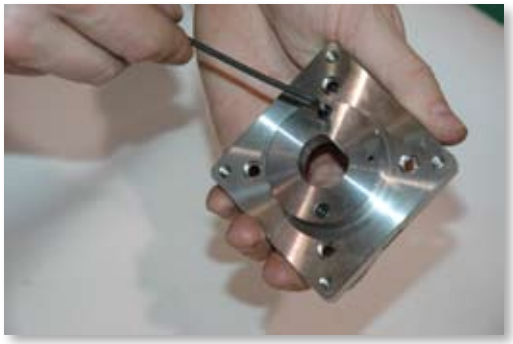
9. Install the cylinder top seal - PNOR2-038.

10. Assemble cylinder top to the cylinder bottom.



11. Apply anti-seize to the SHCS's.
12. Install the cylinder top SHCS's.
13. Install the Piston Collar to the Mounting Base.



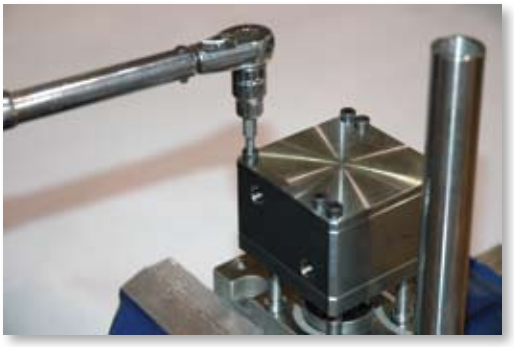


14. Assemble the cylinder mounting base to the manifold.

15. Apply anti-seize to the SHCS's.
16. Tighten all SHCS's in a crossing pattern.

17. Torque all SHCS's in a crossing pattern.

18. Assemble the cylinder to the mounting base.
19. Apply anti-seize to the SHCS's.
20. Tighten all SHCS's in a crossing pattern.
21. Torque all SHCS's in a crossing pattern.



# Section 5 Assembly

## Introduction

This section is a step-by-step guide to assembling your ***Mold-Masters*** Fusion G2 hot runner system.

## Gate Seal Finishing

Most nozzles are supplied with the gate seal installed (except when the seal requires final machining by a toolmaker, such as the Hot Valve / Hot Sprue).

**NOTE:**
The gate seals supplied with your system may need to be adjusted to tolerances based on the material grade and cooling in the cavity. Refer to your ***Mold-Masters*** General Assembly Gate Detail drawing to determine if gate seal finishing is required. Refer to the general assembly drawing to determine which gating method applies.

## Hot Valve / Hot Sprue / F Type

Hot valve and hot sprue gated systems are supplied with gate seals that are oversize in length. They must be machined prior to installing the nozzle into the nozzle well bore.

**NOTE:**
Heat expansion of the nozzle must also be taken into consideration.

Contour of gate seal should be done at process temperature.

Check the chart on the general assembly drawings for the length and contact height required.

See Contact Length "H" on table below.

**CAUTION:**
Ensure the thermocouple is not damaged during machining

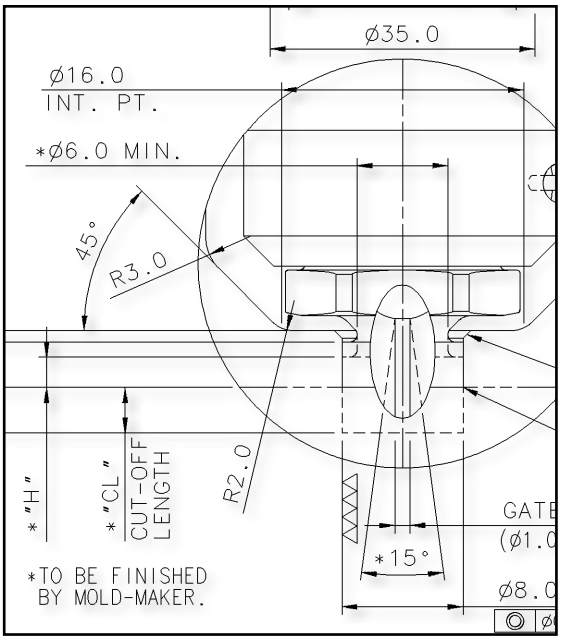



*Figure 5-1 Hot Valve / Hot Sprue Gated System*

| Polymer Structure | Contact Length "H" |
|---|---|
| Amorphous Filled or Reinforced | 4.00 |
| Semi-crystalline Filled or Reinforced | 3.00 |
| Crystalline Filled or Reinforced | 2.00 |

## Pre-Assembly Checks of Gate Seals & Nozzle

**Blue off the gate seal (and liner if relevant) to ensure a proper contact on sealing surface:**
*Note the following example shows gate seal with a liner).

1. Apply die blue to the gate seal and gate seal liner (if relevant).

2. Torque the gate seal to specified value.

3. Remove gate seal and verify transfer of die blue from gate to the liner.

   Verify transfer of die blue to nozzle core.

   If not 100% blue on face contact your Mold Masters representative.

4. Clean die blue from components.

**Blue off nozzle core to manifold:**

1. Inspect threads for burrs.

2. Apply die blue to nozzle core.

3. Apply anti-seize to threads.

4. Assemble nozzle to manifold and torque to specified value.

5. Verify transfer of die blue from nozzle core to manifold.

6. Clean die blue from components.

## Assembly of Gate Seals to Nozzle

1. Apply anti-seize paste to all threaded interfaces.

2. Ensure all sealing surfaces are clean and dry.

3. Install gate seal and liner.

4. Torque to specified values.

## Nozzle Assembly

**Install nozzle heaters and sleeves**

1. Install heaters and sleeves per specified drawings.

**Install thermocouple.**

1. Insert thermocouple into slot until bottoms out.

2. Bend thermocouple 180 degrees.

3. Install thermocouple retainer clip.

## Install Heater Retaining Clip

1. Using snap ring pliers, expand the clip and install into snap ring groove on nozzle core.

## System Assembly

## Assembly of Nozzle to Manifold

1. Follow pre-assembly checks mentioned earlier in the section.

2. Apply anti-seize to nozzle threads.

3. Assemble nozzle to manifold.
   Torque nozzles to specified value.

## Manifold Locator Installation

1. Apply anti-seize to socket head cap screws (SHCS).

2. Install manifold locator to manifold and torque SHCS to specified value.

3. Verify height of manifold locator to specified print dimension.

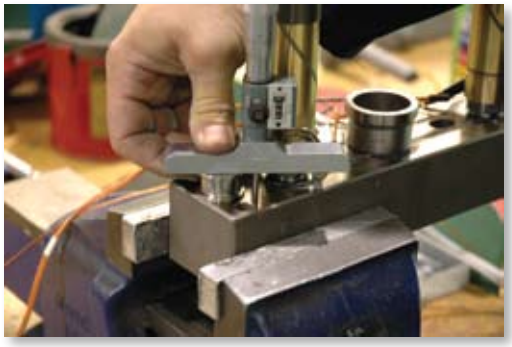
## Install Support Bushings

1. Apply anti-seize to SHCS.

2. Install support bushing to manifold and torque SHCS to specified value.

3. Repeat for other support bushings (typical application will require 1 support bushing per nozzle).

4. Verify height of support bushing and manifold locator to print specifications.



## Install Manifold Thermocouple

1. Ensure thermocouple holes in manifold are clean and free of blockage.

2. Install manifold thermocouple into manifold thermocouple hole until it bottoms out in the hole.

3. Bend thermocouples into slot.

4. Install manifold ground strap and thermocouple retention screw combination.

## Install Inlet

1. Apply die blue to bottom of inlet.

2. Apply anti-seize to SHC screws and install inlet to manifold.

3. Torque screws in a crossing pattern gradually increasing torque to specified value.

4. Remove inlet to verify blued surfaces.

   If not 100% blue on face, contact your Mold Masters representative.

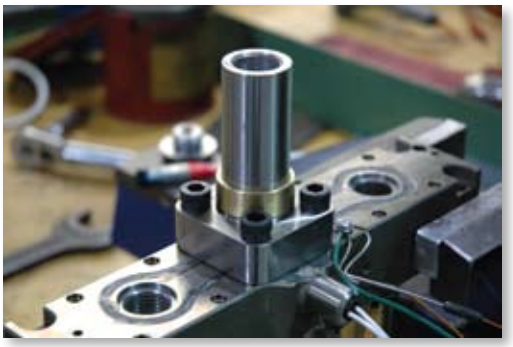
5. Clean the die blue from the inlet and manifold.

6. Re-install inlet. Torque screws in a crossing pattern gradually increasing torque to specified value.

7. Blue the inlet seal and verify blued surfaces to check fit of seal in the inlet.

8. Clean blue from inlet seal and inlet.

9. Install inlet heaters and sleeves per specified drawing.



10. Apply anti-seize to threads and install inlet seal to inlet.

11. Torque to specified value.

## Install inlet thermocouple

1. Install thermocouple into slot until bottoms out.

2. Bend 180 degrees.

3. Install thermocouple clip.

## Install valve bushing

1. Blue valve insert.

2. Install valve insert into valve nut.

3. Apply anti-seize to the SHCS's.

4. Install the SHCS's in a crossing pattern.

5. Remove valve bushing, and verify blue on all surfaces.

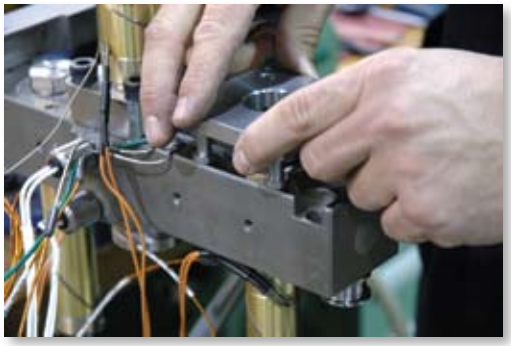
6. Clean bluing from all components.

7. Install and torque in a crossing pattern.

8. Install valve pin to verify fit.

## Install Cylinder to Manifold (Pneumatic)

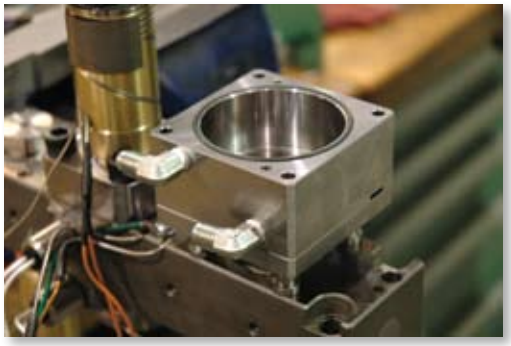
1. Install pneumatic cylinder mounting plate to manifold.



2. Apply anti-seize paste to SHCS.

3. Torque screws in a crossing pattern gradually increasing torque to specified value.

4. Place cylinder housing onto cylinder mounting plate.



5. Insert valve pin into piston.

6. Apply anti-seize paste to piston top.

7. Install piston top into piston.

8. Install piston into cylinder housing.

9.Install cylinder top o-ring.

10. Install cylinder top.

11. Apply anti-seize paste to SHCS and torque screws in a crossing pattern gradually increasing torque to specified value.

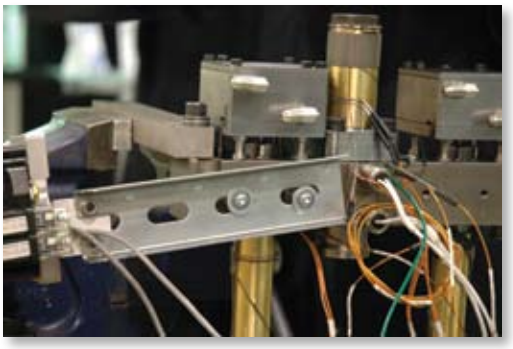
## Wiring

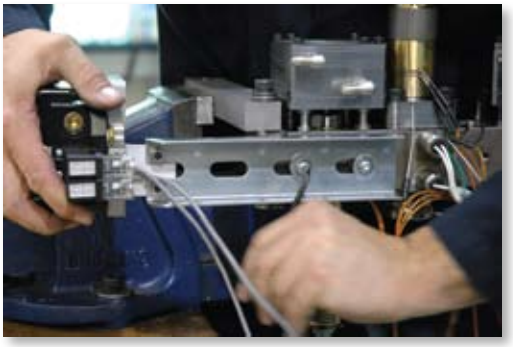
### Attach Wire Armor to Side of Manifold

1. Apply anti-seize to button head cap screws (bhcs).

2. Install  bhcs screws through appropriate slot in wire armor.

3. Add spacer.





4. Install assembly to manifold.

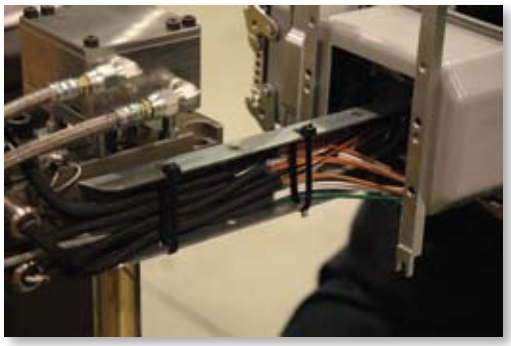
## Wiring

1. Group thermocouple and heater wires for a single zone together and install high temp wire sheathing.

2. Label all heater and thermocouple zones.

3. Use heat resistant tape to tape/group thermocouple heater zones together to avoid losing labels.

4. Repeat for all zones.



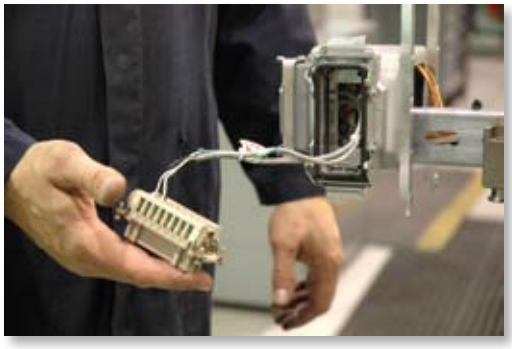
## Electrical Routing into Electrical Box

1. Install thermocouple and heater wires into electrical plugs per wiring schematic.

2. Install plugs into electrical box

## Solenoid Valve Wiring

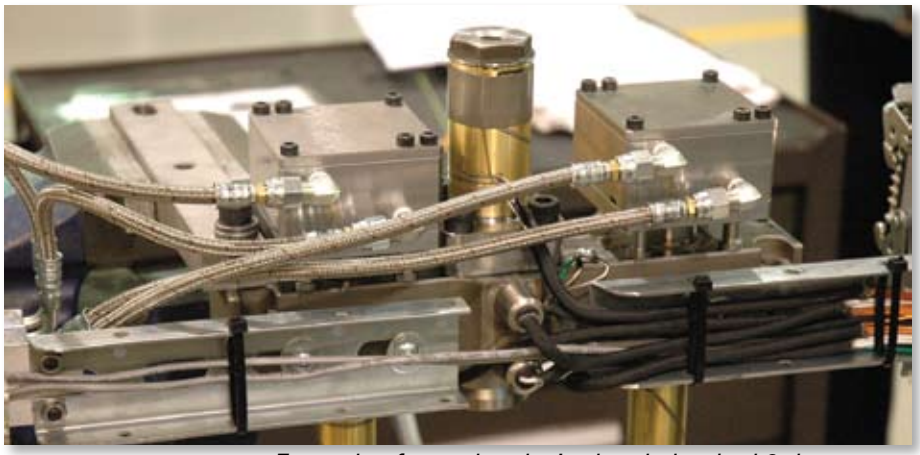
1. Install solenoid coil wires into electrical plugs per wiring schematic.



2. Install plugs into electrical box.

## Plumbing cylinders

1. Install hoses per drawing schematic.



*Example of completed wired and plumbed 2-drop system*

# Section 6 Electrical Testing

## Introduction

This section contains electrical test procedures for your Mold-Masters hot runner system.

**WARNING:**
To avoid serious burns wear safety clothing consisting of a protective heat-resistant coat, heat-resistant gloves and a full face shield over safety glasses. Use adequate ventilation for fumes.

Contact with heated components may cause serious burns. Use a sign in a visible location indicating "Danger: Do Not Touch".

Before performing any electrical work. Check that the hot runner is suitably grounded. off the temperature controller and disconnect all electrical wires leading from the mold. Failure to do so could result in a serious injury or death.

## Wiring Check

**IMPORTANT:**
Ensure that a qualified electrician performs all wiring.

1. Check that each wire and thermocouple has a zone number.
2. Check that wires are organized and taped together by zone and plug.
3. Check all wires are secured in wire channels..
4. Connect all power leads and thermocouple wires to mold plugs.
5. The electricity mains should only be connected to the injection mold when all electrical connections are grounded and the mold is closed.

**WARNING:**
A disassembled nozzle should only be connected to an electrical supply when the nozzle has been grounded or a safety isolating transformer is used.

## Ground Shorts Test

1. Use an ohm meter to check for continuity between the Mold Power Connector ground pin (metal tabs on side) and the manifold steel. The ohm reading should be zero.
2. Measure the resistance between each pin of the Mold Power Connector (See Figure 6-1) and ground (mold base). The reading should be ∞ (infinity). Occasionally, the electric heaters accumulate moisture, which can reduce the resistance value to between 100 KΩ to 10 MΩ. The controller should be designed to remove this moisture during start-up. Never apply full power to a heater if the insulation resistance reading is below 300 KΩ. Heater resistance above 500 KΩ is acceptable. Also check this if the mold has not been in use for a number of weeks/months.
3. If necessary, remove excess moisture before placing the heater under full current.

## Thermocouple Continuity Test

1. Measure the resistance between each pair of thermocouple wires on the mold's Thermocouple Connector. (See Figure 6-1). The resistance should be between 2.5 Ω and 25 Ω.
2. To verify alignment of thermocouple to heater, turn ON one zone at a time & check that the temperature responds accordingly when the set temperature is adjusted.


*Figure 6-1 Mold Plug*
*1. Mold Power Connector*
*2. Thermocouple Connector*

## Pinch Point Test

1. If there is a suspected pinch point on the thermocouple, remove the thermocouple from the hot runner.
2. Connect a controller to read the temperature.
3. Immerse the sheath of the thermocouple in boiling water at the point that the thermocouple reads the temperature.
4. A good thermocouple will show a temperature rise as soon as the tip of the thermocouple is immersed in water. If there is a pinch point in the thermocouple there will be no change in the reading until the pinch point on the thermocouple is immersed in water.

## Heater Continuity

Measure the resistance between each pair of heater power wires at the Mold Power Connector.

Compare your reading with your general assembly drawing.
Where:

R = resistance V = voltage P = power $R = \frac{V^2}{P}$

## Thermocouple Wiring Guidelines

- The thermocouples are type "J" grounded and are color coded to ASA standards. (White "+"/Red "- ").
- The tip must not be cut or crimped, and must touch the bottom of the bore in order to measure the correct temperature.
- Each heat source should have its own closed loop temperature control in order to achieve accurate control.
- If there are not enough control zones, heat sources that have the same wattage and effect the same environment, may be grouped together.

## Heating Test with a Temperature Controller

- Never start the heating with more than 40% of power.
- Stay a minimum of 5 minutes at 212°F (100°C) before increasing heat.
- Stay with the system and monitor the initial heating to minimize risk.

# Section 7 System Installation

## Introduction

The following section is a step-by-step guide to install your ***Mold-Masters*** Fusion® G2 Series hot runner into the existing Manifold Plate System or Spacer Block System.

## Assembling the Fusion® G2 Series System

**NOTE:**
Refer to the general assembly drawings for instructions.

**WARNING:**
Make sure the lifting eyebolt, lifting chain and crane are rated to adequately support the weight of the plate(s). Failure to do so can cause a serious injury.

1. Attach a crane that is rated to adequately support the weight of the cavity plate.
2. Check that all wires are retained.


**CAUTION:**
Do not assemble/disassemble cavity plate with the valve pins forward.
Valve pins must be retracted prior to cavity plate installation.


**CAUTION:**
Potential pinch point. Ensure that all wires are in the retainer groves.
Failure to do so can cause lost production due to hot runner down time.

**WARNING:**
Make sure the machine has been locked out and tagged out in accordance to the machines documented procedures. Failure to do so may lead to serious injury or death.

## Manifold Installation

### Unpacking

1. Carefully open the shipping crate and inspect contents. Secure loose items and check for any damage. Remove any documentation or spares packages and set aside.

2. After removing all restraints, attach the sling to the hoist and carefully remove the manifold assembly from the shipping crate.

3. Verify all dimensions and tolerances and prepare manifold for insertion into the mold cavity.

4. Prepare mold cavity for Fusion G2 Series manifold insertion. Mold type illustrated can be a Spacer Block System or a Manifold Cavity System.

5. Clean all surfaces and dowel holes, ensuring that no debris, burrs, shavings, dust, dirt, or other foreign material which could interfere with measurements, exists. Ream holes out  if necessary.

## Pre-Installation

1. Verify all dimensions, tolerances, angles, taps, chamfers, etc. of the mold, against the engineering and general assembly drawings.

   Record values for future reference (right on the mold is suggested), using a Sharpie style marker.

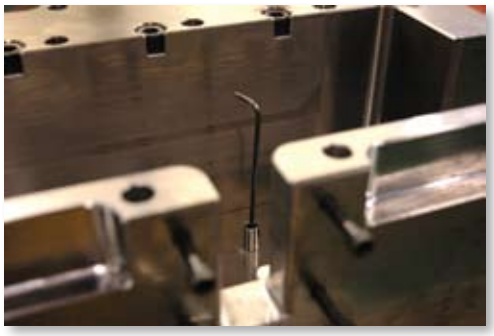
2. Verify centres, depth tolerances, radii against general assembly drawings.

## Install Manifold Locator Dowel

1. Using a depth micrometer, verify the dimensions of the manifold locator pocket to those specified on print.

2. Apply anti-seize paste to SHCS.

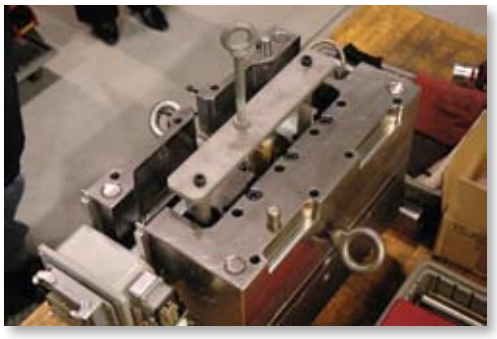
3. Install manifold locator dowel.



## System installation

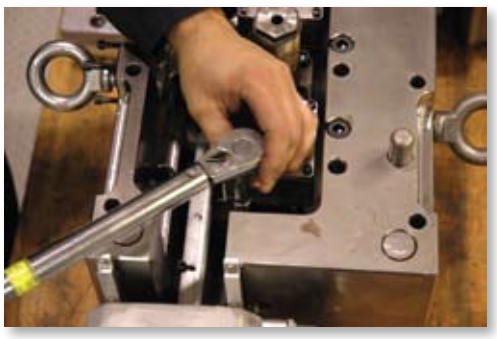
1. Carefully install system into mold ensuring manifold remains level to avoid damage to nozzle wiring. Lower system and check system is completed seated with tool.

2. Remove installation tool (lift bar, etc.).

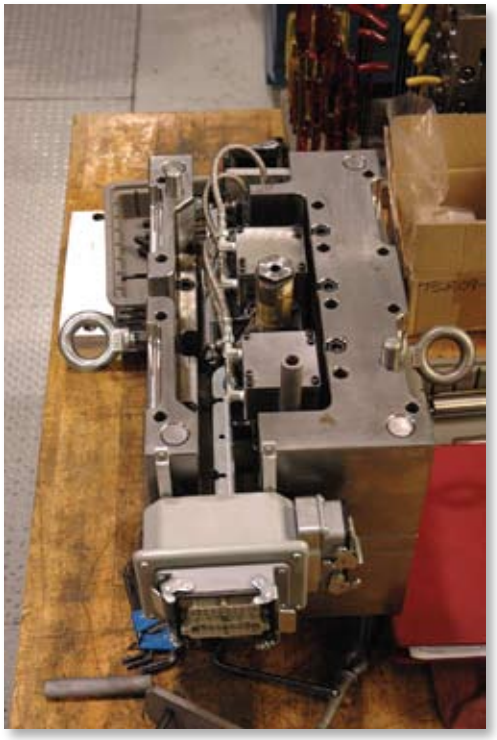


3. Apply anti-seize to system screws and install screws.

4. Torque system screws in a crossing pattern. gradually increasing torque to specified value.



5. Install socket cap srews to secure electrical and solenoid interface to exterior of mold base.



6. Install clamp plate.

# Section 8 System Start Up & Shut

## Introduction

This chapter explains how to start up and shut down your Fusion-Series hot runner system.

## Pre-Start-up

1. Install the mold into the molding machine.

**NOTE:**
Ensure the machine nozzle orifice matches or at most is 1.0 mm (0.040") smaller than melt entrance for the hot runner system.

2. Connect all water lines and test. Water temperature is not to exceed 85° F. Water to Fusion Valve Actuators must be turned on before heating is activated.

3. Connect all hydraulic / pneumatic lines (if applicable).

**NOTE:**
After the hot runner system is installed in the molding machine make sure to bleed all the air out of the hydraulic lines. Possible high gate vestige could occur.


**CAUTION:**
Check that the system is heated to processing temperature. Failure to do so could cause damage to the valve pins. Water must be turned on for Fusion Actuation before turning on temperature controls. Actuator water temperature cannot exceed 85° F.

4. Test the pin actuation (if applicable), only if the hot runner is at processing temperature.

5. Connect all electrical components.

## Start-up

**WARNING:**
Assume the system is pressurized and hot at all times. Failure to do so can result in a serious injury or death.

**NOTE:**
When running thermally sensitive materials, use a thermally stable material as recommended by the material supplier for the initial start-up.

1. Turn ON the machine barrel and mold cooling system.

2. Prior to start-up, ensure the:

   - Fusion Valve Gate Actuator water must be on. Maximum inlet water temperature not to exceed 85° F.
   - Machine barrel is up to processing temperature.
   - Mold cooling is on and at cooling temperature.

3. Heat up the hot runner system to processing temperature.
   Wait until ALL heating zones reach processing temperature before continuing.

**WARNING:**
When the mold is open never inject material through hot runner system under high pressure. Failure to do so can result in serious injury or death.

4. Start-up (only for empty hot runner system).
   Extrude material through the hot runner system using 200 PSI (14 bar) of back pressure.

5. Start-up (for systems filled with material).
   Purge intended shot size twice from the barrel prior to bringing the machine barrel forward to the hot runner interface.

6. Set injection time and pressure in coordination to part size, gate size and material.

**NOTE:**
For hot runner systems using heater plates, allow 20 minutes of soak time after the system reaches processing temperature.

**CAUTION:**
Failure to follow the above procedure may result in leakage/damage occurring in the hot runner.

## Shut Down

1. Turn OFF all heat to the system.

2. Leave the mold cooling system ON, including valve actuator water, until the hot runner system temperature is within 100°F (37.7°C) of the mold temperature.

**NOTE:**
Thermally sensitive materials should be purged from the hot runner system prior to shut down using a thermally stable material with a similar processing temperature. For example, a system running PVC should be initially started and subsequently shut down on LDPE.

# Section 9 Color Change

## Introduction

This chapter explains how to process your Fusion-Series hot runner system.

## Color Change

In order to change from one color to another, it is necessary to remove all traces of the first color from the injection molding system. Refer to the following procedures to assist in performing the color change.

Before commencing color change, review the following warnings.

**WARNING:**
To avoid serious burns when purging wear safety clothing consisting of a protective heat-resistant coat, heat-resistant gloves and a full face shield over safety glasses. Use adequate ventilation for fumes.

**WARNING:**
Do not look directly into the feed throat of a hopper. Unexpected release of resin may cause serious burns. Use a mirror. Failure to do so may cause serious injury.

**WARNING:**
Never handle plastic purgings or drool until they have completely cooled. Purgings may appear solid but may still be hot and cause serious injury.

## Color Change for a Hot Tip / Sprue System

1. System is up & running with one color.
2. Back off machine barrel, purge and introduce new color.
3. Increase hot runner system temperature on all zones 30° - 40° F above processing temperatures.
4. Increase injection speed.
5. Run 10 - 15 shots.
6. Back off injection unit and switch off all heat on the hot runner. Leave Mold cooling on.
7. Allow hot runner system to cool down. This pulls old material away from runner walls .
8. Turn ON the hot runner system and heat to processing temperature.
9. Bring machine barrel back in.
10. Increase injection speed and (mold temperature) until color change is acceptable.
11. Continue processing while resetting hot runner system temperatures and injection speed

**WARNING:**
Some plastics develop gases that may be dangerous to personal health. Follow the plastics supplier's recommendations. Review their material safety data sheet. Ensure the molding area is well ventilated. Failure to do so can result in a serious injury or death.

## Color Change for a Valve Gate System

1. When the system is up and running with one color, back-off the injection unit, purge and introduce the new color.
2. Start molding the new color until the majority of old color has been removed from the hot runner system.
3. Back-off the injection unit and switch off all heats on the hot runner system.

**CAUTION:**
Do not activate the valve gate while purging or feeding the barrel, unless the hot runner system has reached normal processing temperature.

4. Allow the hot runner system to cool down. Leave mold water cooling/actuator cooling on. This pulls old material away from the runner walls and allows new and old color to mix.
5. Heat up the system and start molding.

## Locating the Source of Contamination by a Previous Color

1. Purge the original color from the machine, following the instructions in:
   - Color Change for a Hot Tip / Sprue System
   - Color Change for a Valve Gate System
2. Load the hopper with a 2nd color (different from the intended color).
3. Continue to purge until no trace of the 1st color appears.
4. Shut off the hopper and continue to remove the 2nd color, following the instructions above.
5. Load the hopper with the 3rd, and final intended color.
6. Purge the 3rd color through the injection unit to clean the injection unit of the 2nd color. Continue to purge until no trace of the first color appears.
7. If the 2nd color appears in the molded product then the problem is in the injection unit.

# Section 10 Troubleshooting

## Introduction

This troubleshooting information assumes that the hot runner has been operational.

Basic rules for troubleshooting are:

- Define the problem; what is seen is only a symptom of the underlying problem.
- Develop a method to isolate the problem.
- Test one item at a time to verify results.
- Monitor the final solution to verify that the problem has been solved. Repeat occurrences of the same symptom may indicate other problems.
- Document the solution so that a repeat occurrence can be solved quickly.
- Consult other resources to augment the troubleshooting information in this manual. One of the best resources may be your resin supplier.

**NOTE:**
Refer back to **Section 3: Safety** for proper procedures to be followed.

**WARNING:**
Extreme heat. Avoid contact with heated surfaces. To avoid serious burns wear safety clothing consisting of a protective heat resistant coat and heat-resistant gloves. Use adequate ventilation for fumes. Failure to do so can result in a serious injury.

Make sure the machine has been locked out and tagged out in accordance to the machines documented procedures. Failure to do so may lead to serious injury or death.

## Moisture Related Issues

Many common molding issues can be directly attributed to moisture contamination of the production resin.
Generally, manufacturing resin is supplied from the manufacturer in ready to process pellets that are in sealed, airtight containers. Follow manufacturers storage instructions, keeping containers sealed until ready to use.
Prior to using pellets, follow the drying instructions, as provided by the resin supplier and molding machine manufacturer (if applicable).

### Resin Moisture Contamination

Moisture can be introduced into the resin in many ways:

- during transportation
- environmental exposure (aging)
- malfunctioning heater/dryer
- extreme humidity in atmosphere
- inadequate or malfunctioning facility HVAC

### Resin Drying Issues

During the drying stage of the resin (if applicable), ensure that:

- the resin pellets are not overpacked
- adequate air circulation is present
- the drying system is properly sealed, according to manufacturers instructions

### Importance of Pre-Drying Resin

Thermoplastic resins can be hygroscopic, able to absorb moisture from the air. Under normal processing conditions, this can lead to degradation of the polymer during molding. Breakage of polymer chains changes the properties, resulting in possible blisters, streaks, splay or other defects described in this section.

Recycled resins can have higher hygroscopic properties due to greater surface area and should be dried separately from fresh resins.

If moisture issues are ruled out, continue with the troubleshooting tables in the following pages.

## Pre-Molding Precautions

Prior to commencing production, ensure that the following conditions have been met. This will greatly reduce any future need to troubleshoot defective production.

### History

- Review any documentation associated with your batch job regarding the recipe using the mold, molding machine, thermoplastic resin, environmental setting, etc.
- Review comments, notes, logbooks, blogs, and anything other resource material that pertains to the batch job.
- Verify that all settings such as all time, temperature, pressure, material, etc are correct.

### Material

- Ensure that the thermoplastic resin to be used is the right grade, and has been stored and/or prepared/dried, etc, according to manufacturers specs.
- Verify that the pigment/dye to be used meets manufacturers specifications, and is compatible with the resin/molding machine/mold.
- Verify the correct recycle ratio and adjust settings accordingly.

### Hardware

- Make sure the mold has been properly stored, and is dry, clean, free of rust, dirt, moisture, residual resin, pigment and any protective coating.
- Check that the temperature controller meets requirements, and is fully tested and operational.
- The injection molding machine has been properly maintained, cleaned, lubricated; tolerances and dimensions verified.
- Make sure that the nozzles, cylinders, valves, gates, and any other variable that is appropriate for the batch job has been chosen.

### Settings

- Ensure that all batch job parameters are correct:
  - Temperatures
  - Pressures
  - Injection Speed
  - Back Pressure

## Establishing Root Cause

This section is to be used as a reference tool only.

When a system that has been set up according to specification and was functioning normally suddenly produces sub-standard parts, the data in the following pages may be used to determine the possible cause, but only should be used as a guide.

A correct set up procedure that has been proven in will produce parts that meet design tolerances and specifications. A sudden change in any parameter indicates a possible fault. Rather than modify other settings to compensate for this variation, it is advisable to determine which of the original settings has changed.

### Fault Identification

The operator will need to evaluate all the possible conditions which may have caused the defect.

- Identify the problem
- Determine the frequency
- Is the problem random or in the same location
- Review past history logs for similar occurrences and resolutions.

Review the machine settings to ensure that there is no variation from the original set-up which was producing standard parts.

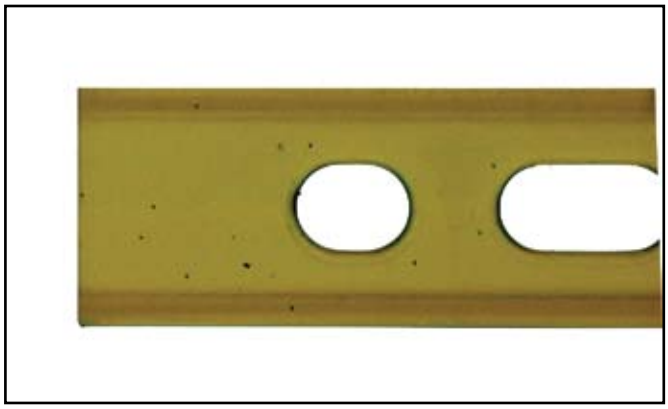
- injection speed
- screw speed
- melt temperature
- back pressure
- melt heating
- locking
- cushion
- mold heating

For a more thorough analysis of the defect, refer to the **Troubleshooting Section** in the following pages.

## Defect types, causes and remedies index

## Parts Have Dark Specks

The finished product contains dark particles.
(When transparent resins are usually used.)



### Probable Cause:

**Molding Machine**

- Off line for extended period
- Barrel offline for extended period
- Barrel improperly purged
- Contamination in plasticizer
- Wrong nozzle
- Use of wrong screw

**Mold**

- Gate and/or runner has dead spots

**Material**

- Physical contamination of raw material
- Chemical contamination of raw material
- Particulate contamination from machine barrel

### Solution (In sequence):

- Purge system with appropriate material
- Trace source of contamination and repair, remove or discard
- Adjust melt temperature if necessary
- Inspect for dead spots: gates; runners; nozzle; back flow valve
- Inspect feed screw for degradation

## Parts Have Blisters and/or Bubbles

The finished product contains small gas or air filled pockets or cooling voids.

### Probable Cause:

**Molding Machine**

- Low Injection Pressure
- Back flow valve malfunctioning
- Suck-back cycle too long
- Rapid plasticizing
- Trapped air in feed
- Feed error

**Mold**

- Trapped or volatile gas
- Low mold temperature
- Poor thin/thick transition phase
- Inadequate venting

**Material**

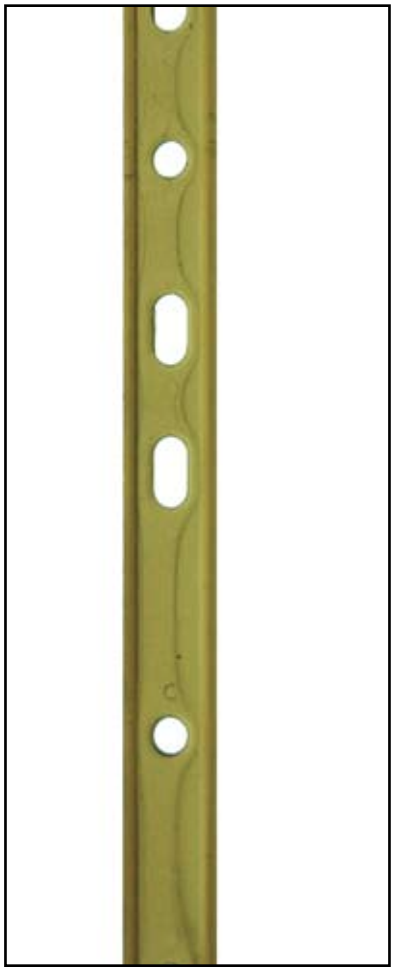
- Overheating of resin

### Solution: (In sequence)

- Verify control and/or holding pressure
- Increase back pressure
- Increase mold temperature
- Inspect back flow valve
- Ensure proper venting
- Increase gate size
- Decrease vent land length

## Parts Have Flow Marks

The finished product exhibits blush and flow marks, due to variations in material temperature from gradients between the machine nozzle and mold sprue bushing. Cold material in the nozzle tip section results in a halo around the direct sprue.



### Probable Cause:

**Molding Machine**

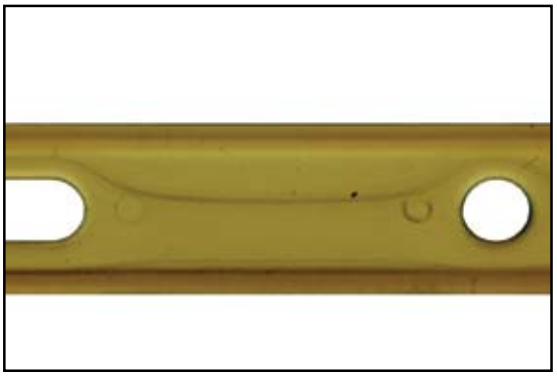
- Wrong injection speed
- Wrong injection pressure
- Hold pressure too long

**Mold**

- Insufficient mold cooling
- Temperature of mold too high around the gate
- Temperature of mold too cool
- Gate size is too small
- Gate is in wrong location
- Land length of gate is too long
- Incorrect hot runner system

**Material**

- Melt temperature is too low



### Solution (In sequence):

- Adjust injection speed
- Add a large cold slug area
- Add cold wells at the end of the runner system
- Use hot sprue bushing
- identify and eliminate dead pockets /sections

## Parts Have Burn Marks

The finished product display brown streaks. This is from the material being overheated due to trapped air (diesel effect), which can lighten or darken the color.

### Probable Cause:

**Molding Machine**

- High injection speed
- Backflow/check ring valve malfunctioning
- High back pressure

**Mold**

- Trapped or volatile gas
- Burning due to friction
- Incorrect sprue diameter

**Material**

- Overheated/underheated melt, possible shear

### Solution: (In sequence)

- Clear blocked vent channels
- Lower injection speed
- Lower injection pressure
- Check heater functionality
- Check thermocouple functionality
- Reduce feed screw rotation
- Reduce melt temperature
- Increase mold cavity venting
- Enlarge gate
- Change gate position and/or size

## Parts are Delaminating

The finished product is separating into layers that can be peeled off; surface layers are flaking off. Insufficient layer bonding as a result of high shear stresses; non-homogenious material.

**Probable Cause:**

**Molding Machine**

- High injection speed

**Mold**

- Cold mold
- Gate has sharp corners
- Sharp corners causing shear heat

**Material**

- Physical contamination of raw material
- Chemical contamination of raw material
- Melt too hot; poor melt
- Incompatible color dye
- High percentage of recycled material

**Solution (In sequence):**

- Melt temperature increased
- Mold temperature increased
- Injection speed decreased
- Contamination eliminated
- Regrind ratio adjusted
- Resin moisture content adjusted/changed
- System purged
- Sharp corners at gate reduced

## Parts Have Dimensional Irregularities

The finished product is of a different dimensional value than originally designed, or previous production.


### Probable Cause:

**Molding Machine**

- Low injection pressure
- Short hold pressure time
- Damaged back-flow/check ring valve
- Short cycle time
- Cylinder clearance too big
- Nozzle heaters malfunctioning

**Mold**

- Temperature setting too high
- Small gate size resulting in wrong pressure
- Incorrect gate location
- Incorrect mold configuration/size

**Material**

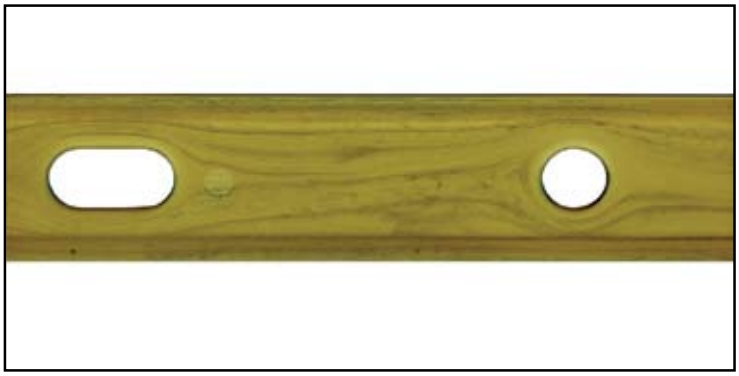
- Generally not a material related issue unless excessive regrind is used.

### Solution: (In sequence)

- Increase the injection pressure
- Increase the cooling time
- Increase the mold temperature
- Ensure cycle time is consistent
- Monitor molding machine for irregularities
- Balance regrind ratio
- Increase gate size
- Decrease gate land length
- Balance the runner and/or gate system
- Decrease cavity quantity

## Parts are Discolored

The finished product varies in color on different surfaces.



### Probable Cause:

**Molding Machine**

- Contamination

**Mold**

- Incorrect sprue diameter
- Inadequate venting

**Material**

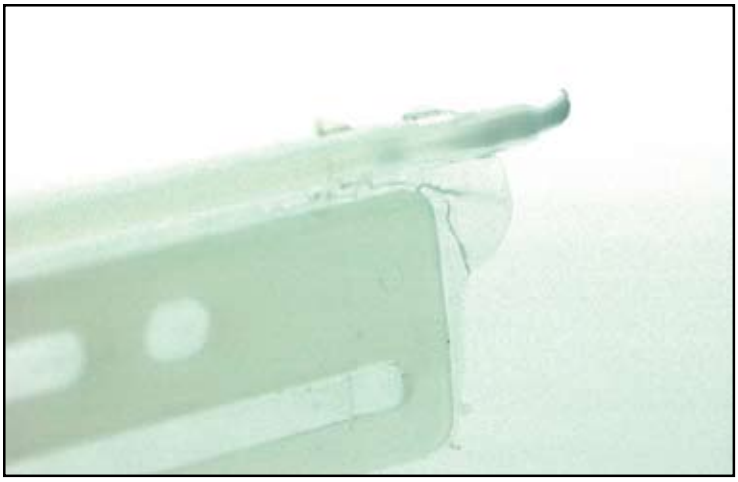
- Physical contamination of raw material
- Chemical contamination of raw material
- Melt too hot; poor melt
- Incompatible color dye
- Residence time too high

### Solution (In sequence):

- Heating cylinder purged
- Resin temperature lowered by:
  a. reducing cylinder temperature.
  b. reducing screw speed
  c. reducing back pressure
- Nozzle temperature decreased
- Residence time adjusted
- Regrind ratio adjusted
- Cycle time adjusted
- Check for external contamination sources
- Ensure proper cooling in all areas.
- Increase mold venting

## Parts contain Flash

Also known as "Fins" or "Spew"
The finished product contains a thin film of material attached at the mold parting line.



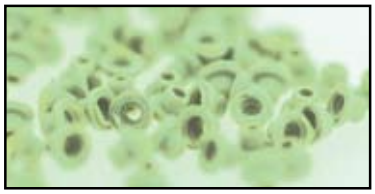
### Probable Cause:

**Molding Machine**

- Low clamping pressure
- High injection pressure
- High injection speed

**Mold**

- Inadequate mold supports
- Low clamping force
- Damaged mold
- Projected area too large for machine capacity



**Material**

- Low melt viscosity
- High melt temperature

### Solution: (In sequence)

- Reduce the injection speed
- Reduce the injection pressure
- Reduce the injection time
- Increase clamping force
- Inspect the mold for irregularities
- Reduce the melt temperature
- Inspect vent depth
- Switch to higher tonnage clamping machine
- Establish correct transfer position
- Reduce hold pressure

## Parts surface has Jetting

The finished product exhibits serpentine flow patterns on the surface as a result of the melt cooling prior to complete filling of the mold.

### Probable Cause:

**Molding Machine**

- High injection speed

**Mold**

- Cold mold
- Small gate
- Wrong gate land length
- Wrong gate location

**Material**

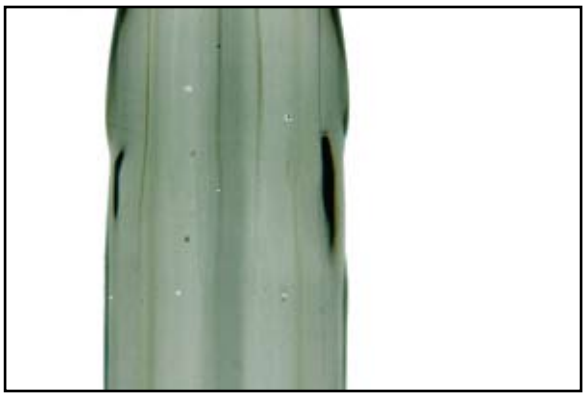
- Cold melt

### Solution (In sequence):

- Decrease injection speed
- Verify nozzle temperature
- Increase mold temperature
- Increase melt temperature
- Increase gate size
- Modify gate location

## Parts are Pitted

The finished product contains unmelted particles or small holes on the surface.



### Probable Cause:

**Molding Machine**

- Improper or worn out feed screw
- Low melt temperature
- Low injection speed

**Mold**

- Gating shear
- Sharp corners

**Material**

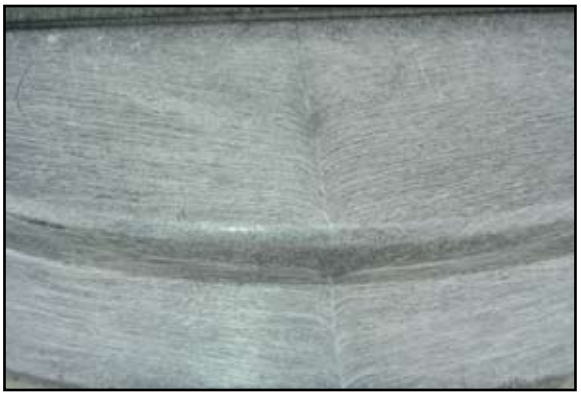
- Resin used is not homogeneous
- External contamination

### Solution: (In sequence)

- Reduce shear
- Reduce back pressure
- Reduce injection speed
- Modify temperature
- Modify regrind ratio
- Modify shot size
- Inspect hot runner and nozzles

## Parts surface is Rough

The finished product exhibits patterns on the surface similar to grooves on a record, due to rapid cooling of the melt as it nears mold surface, followed over and over again by fresh melt.



**Probable Cause:**

**Molding Machine**

- Low injection speed
- Low injection pressure

**Mold**

- Cold mold
- Irregularities in mold surface; defective polishi

**Material**

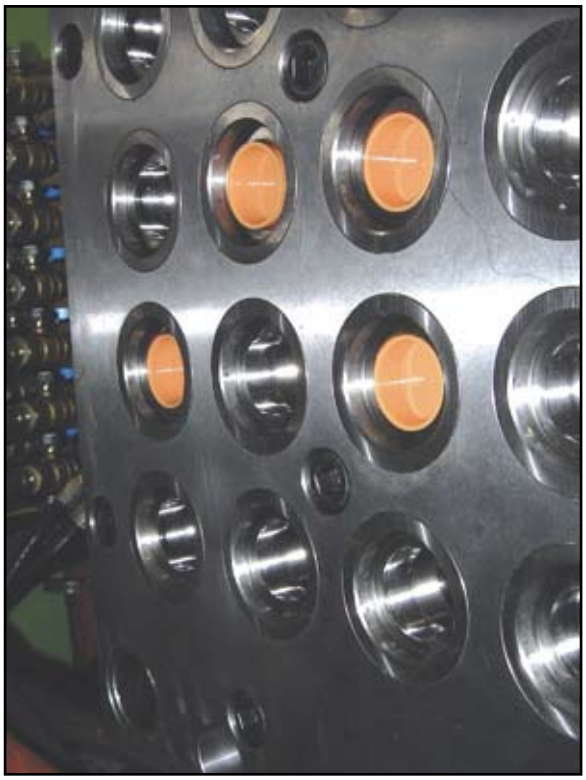
- Cold melt

**Solution (In sequence):**

- Increase injection speed
- Increase injection pressure
- Increase melt temperature
- Increase mold temperature
- Inspect mold surface

## Parts are sticking to cavity

The finished product does not properly release from the mold (female side).



### Probable Cause:

**Molding Machine**

- High injection pressure
- High injection speed
- Long holding time
- High material feed

**Mold**

- Hot cavity
- Cold mold
- Defective mold surface

**Material**

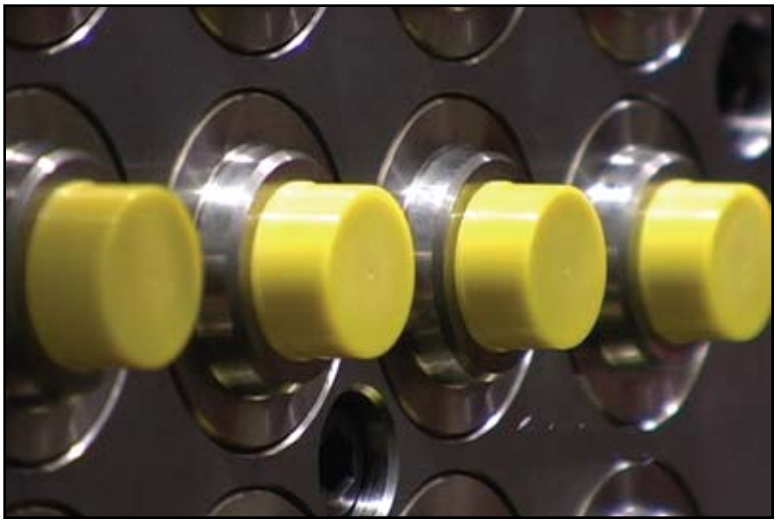
- Melt too hot

### Solution: (In sequence)

- Confirm cycle time for cooling
- Reduce injection pressure
- Reduce injection hold time
- Reduce injection speed
- Reduce injection time
- Adjust feed
- Inspect mold finish
- Increase mold opening cycle
- Lower mold temperature
- Adjust differential temperatures
- Inspect for appropriate mold release

## Parts are sticking to core

The finished product does not properly release from the mold (male side).



**Probable Cause:**

**Molding Machine**

- High injection pressure

**Mold**

- Hot core
- Bending of core
- Presence of vacuum

**Material**

- Generally not a material related issue

**Solution (In sequence):**

- Confirm cycle time for cooling
- Reduce injection pressure
- Reduce injection hold time
- Reduce injection time
- Adjust feed
- Reduce mold closed time
- Increase core temperature
- Decrease nozzle temperature
- Inspect mold for undercuts and/or improper draft
- Verify mold bending ratio

## Parts are short

The finished product is not completely formed.

### Probable Cause:

**Molding Machine**

- Bad feed
- Low injection pressure
- Low injection speed
- Short injection time
- Back flow valve / check ring faulty
- Improper venting

**Mold**

- Insufficient venting
- Cold mold

**Material**

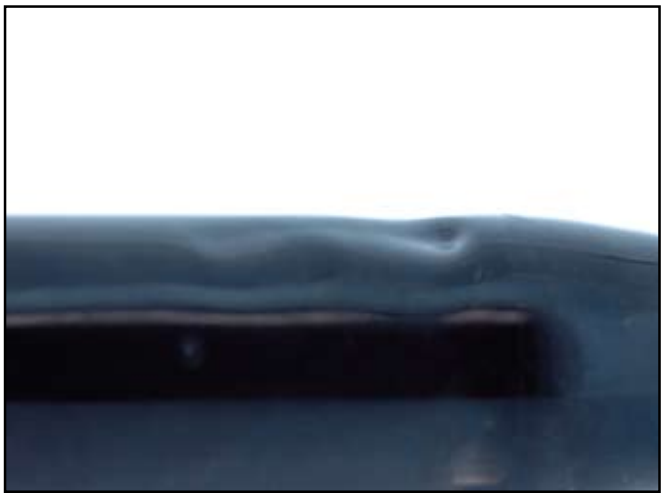
- Low melt temperature
- Viscous material

### Solution (In sequence):

- Increase feed
- Increase injection pressure
- Increase feed temperature by increasing cylinder temperature
- Increase injection time
- Increase mold temperature
- Increase nozzle diameter
- Inspect for restrictions
- Increase gate size of sprue and runner system

## Parts have sinks or voids

The finished product has hollows and pockets in areas that do not cool sufficiently, causing contraction.



### Probable Cause:

**Molding Machine**

- Low injection pressure
- Short injection time
- Insufficient material in cavity
- High injection speed
- Low back pressure
- Damaged backflow valve / check ring

**Mold**

- Mold not at required temperature
- Small gate leading to early freezing
- Gate land length too long
- Incorrect rib/wall dimensions
- Material flow incorrect
- Thick wall part

**Material**

- Hot material
- Material wrong grade for application

### Solution: (In sequence)

- Adjust injection speed
- Increase injection hold time
- Increase injection pressure
- Adjust melt temperature
- Adjust mold temperature
- Inspect for hot spots
- Enlarge and/or add vents to mold parting line
- Increase sprue or runner size
- Increase gate size/reduce gate land length
- Relocate gate closer to heavy/thicker areas
- If possible, core out heavy wall sections

## Parts display splay

The finished product display splay/splash marks and/or silver streaks.

### Probable Cause:

#### Molding Machine

- Resin degraded from overheating
- Cylinder contains hot spots
- Material trapped at nozzle tip
- Wrong injection pressure
- Wrong injection speed
- Low back pressure

#### Mold

- Friction related burning in gate, nozzle or hot runner
- Trapped volatile compounds

#### Material

- Hot melt
- Contaminated resin (moisture, dirt, organics)
- Degraded resin

### Solution (In sequence):

- Dry resin according to procedure; check drying equipment for functionality
- Reduce nozzle temperature
- Reduce material temperature:
  1. lower cylinder temperature; 2. reduce screw speed; 3. reduce back pressure
- Decrease injection speed
- Increase mold temperature
- Decrease or eliminate screw decompression
- Reduce cycle time
- Check for drooling
- Check for contamination in mold cavity
- Open gates
- Try mold in smaller shot-size press

## Parts are streaked

The finished product has large, dull and laminate appearance areas on the surface.

### Probable Cause:

**Molding Machine**

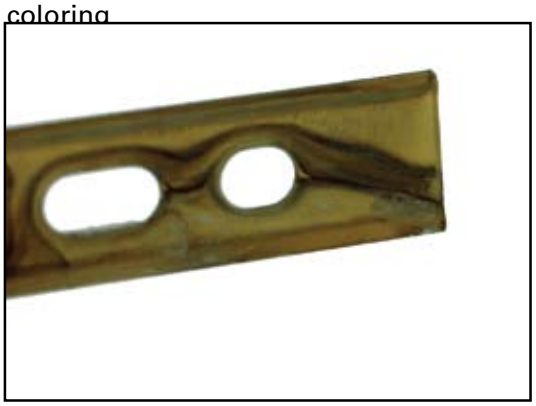
- Back flow valve ring damaged

**Mold**

- Hot spots
- Material trapped in certain areas

**Material**

- Contamination of resin or machine
- If pattern is identical, cause may be the machine
- If pattern is erratic, cause may be the material or coloring
- Degraded or unstable material



### Solution: (In sequence)

- Check for contamination
- Check barrel purging
- Inspect back flow ring for wear or cracks
- Inspect feed screw for wear and tear
- Inspect screw/barrel for tolerances
- Verify heater operation
- Verify thermocouple operation

## Parts are stringing

The finished product have thin plastic strings attached to the sprue.

### Probable Cause:

**Molding Machine**

- High back pressure
- High nozzle temperature

**Mold**

- Incorrect sprue

**Material**

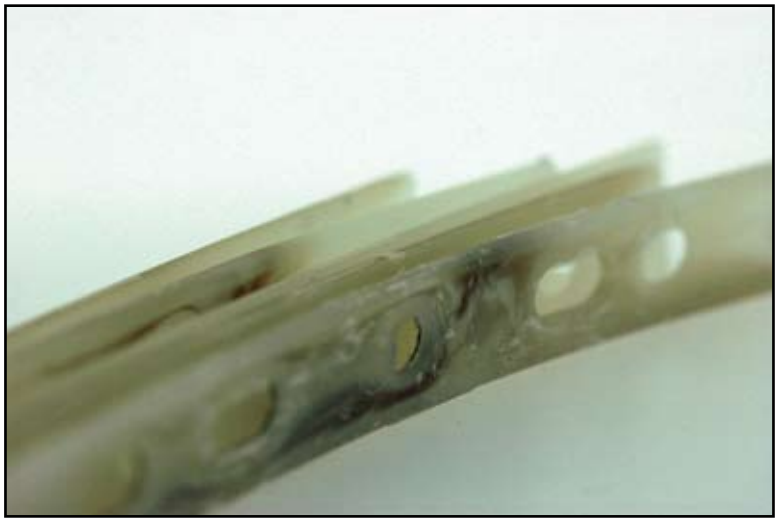
- Melt strength inadequate

### Solution (In sequence):

- Reduce back pressure
- Modify nozzle temperature
- Modify temperature profile
- Eliminate sprue breaks
- Increase cooling time
- Decrease mold temperature at the gate

## Parts are warped

The finished product has pressure differences/stress on its surface, causing the part to be disfigured.



### Probable Cause:

**Molding Machine**

- Wrong cooling time
- High injection pressure

**Mold**

- Gate located in wrong area
- Undercuts too big
- Cavity too hot
- Part is wrong design or too heavy

**Material**

- Fillers have wrong orientation
- Incorrect material

### Solution (In sequence):

- Ensure temperature in both mold halves is equal
- Monitor part ejection from mold for uniformity
- Monitor part handling following ejection
- Verify part weight following ejection
- Increase injection hold time
- Increase cooling time
- Adjust injection pressure
- Adjust mold temperature; set sequential temperatures based on part geometry
- Check gate dimensions, quantities and locations
- Re-design part if necessary

## Parts have weld lines

The finished product has lines where two flow fronts meet and have not fused, creating the possibility of weak areas and stress fractures.

**Probable Cause:**

**Molding Machine**

- Low injection speed
- Low injection pressure
- Short injection time forward

**Mold**

- Low mold temperature
- Poor venting
- Back flow valve / check ring malfunctioning
- Gates too far apart
- Redesign part

**Material**

- Cold melt
- Material wrong grade for application

**Solution: (In sequence)**

- Increase injection pressure
- Increase injection holding time
- Increase injection speed
- Increase cylinder temperature
- Increase mold temperature
- Check for venting
- Provide an overflow well adjacent to the weld area
- Modify the gate location
- Decrease gate land length

NOTE TO MOLD MAKER:

This detailed user manual has been prepared to assist in the integration, processing and troubleshooting of your *Mold-Masters®* System.

When this hot runner system has been integrated into the mold, please ensure that this user manual is forwarded to the molder / end user together with the mold.

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